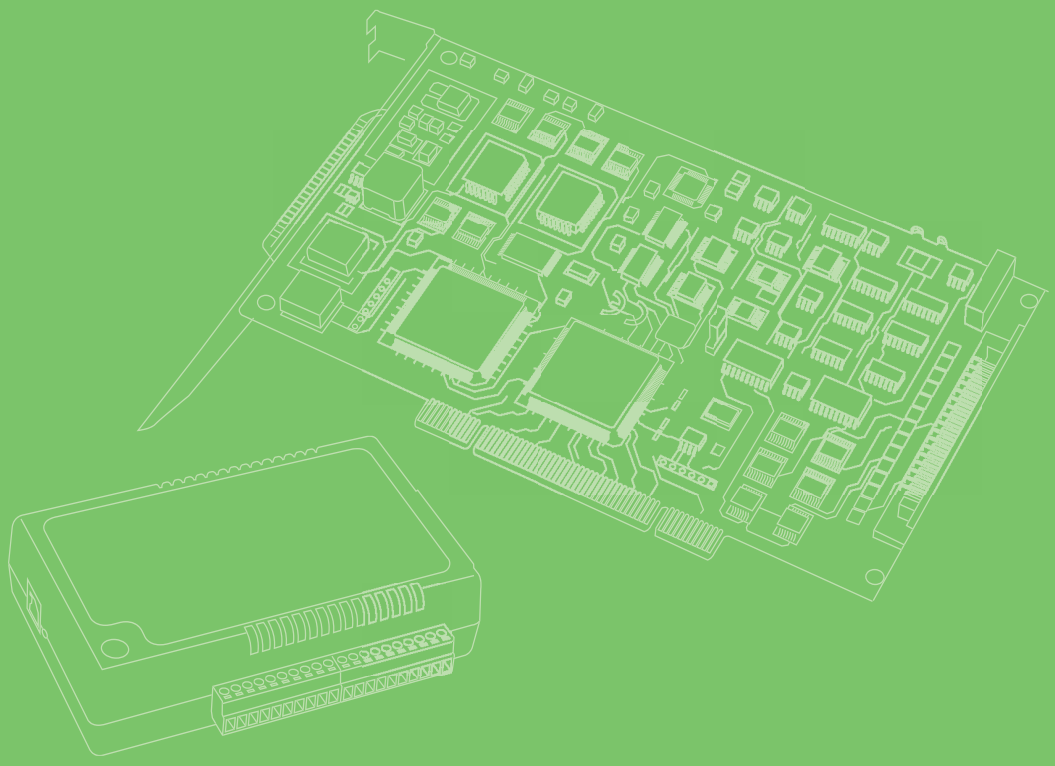

User Manual

PCIE-1805

32-ch, 16-bit, 1 MS/s Analog Input PCI Express Card

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Acknowledgments

Product Warranty (2 years)

Advantech warrants to you, the original purchaser, that each of its products will be free from defects in materials and workmanship for two years from the date of purchase.

This warranty does not apply to any products which have been repaired or altered by persons other than repair personnel authorized by Advantech, or which have been subject to misuse, abuse, accident or improper installation. Advantech assumes no liability under the terms of this warranty as a consequence of such events.

Because of Advantech's high quality-control standards and rigorous testing, most of our customers never need to use our repair service. If an Advantech product is defective, it will be repaired or replaced at no charge during the warranty period. For out-of-warranty repairs, you will be billed according to the cost of replacement materials, service time and freight. Consult your dealer for more details.

If you think you have a defective product, follow these steps:

1. Collect all the information about the problem encountered. (For example, CPU speed, Advantech products used, other hardware and software used, etc.) Note anything abnormal and list any onscreen messages you get when the problem occurs.
2. Call your dealer and describe the problem. Have your manual, product, and any helpful information readily available.
3. If your product is diagnosed as defective, obtain an RMA (return merchandize authorization) number from your dealer. This allows us to process your return more quickly.
4. Carefully pack the defective product, a fully-completed Repair and Replacement Order Card and a photocopy proof of purchase date (such as your sales receipt) in a shippable container. A product returned without proof of the purchase date is not eligible for warranty service.
5. Write the RMA number visibly on the outside of the package and ship it prepaid to your dealer.

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CE

This product has passed the CE test for environmental specifications when shielded cables are used for external wiring. We recommend the use of shielded cables. This kind of cable is available from Advantech. Please contact your local supplier for ordering information.

Technical Support and Assistance

1. Visit the Advantech web site at **http://support.advantech.com.tw/** where you can find the latest information about the product.
2. Contact your distributor, sales representative, or Advantech's customer service center for technical support if you need additional assistance. Have the following information ready before you call:
   - Product name and serial number
   - Description of your peripheral attachments
   - Description of your software (operating system, version, application software, etc.)
   - A complete description of the problem
   - The exact wording of any error messages

Packing List

Before setting up the system, check that the items listed below are included and in good condition. If any item does not accord with the table, contact your dealer immediately.

- PCIE-1805 DA&C card
- Startup or User Manual

Safety Precaution - Static Electricity

Follow these simple precautions to protect yourself from harm and the products from damage.

1. To avoid electrical shock, always disconnect the power from your PC chassis before you work on it. Don't touch any components on the CPU card or other cards while the PC is on.
2. Disconnect power before making any configuration changes. The sudden rush of power as you connect a jumper or install a card may damage sensitive electronic components.

Contents

Chapter 1

Introduction

This chapter introduces PCIE-1805 and its typical applications. Sections include:

- Features
- Applications
- Installation Guide
- Software Overview
- Roadmap
- Accessories

PCIE-1805 is an advanced high-performance analog input card based on the PCIe x1 Bus. With a large FIFO of 4K samples, the maximum sampling rate of PCIE-1805 is up to 1MkS/s shared by maximum 32 channels.

1.1 Features

- 32-ch single-ended or 16-ch differential analog input, up to 1MS/s
- 16-bit resolution for A/D conversion
- ±10 V to ±1 V voltage measurement
- 0 ~ 20 mA or 4 ~ 20 mA current measurement
- Full auto-calibration
- Supports digital and analog triggers
- Multi-card synchronization

PCIE-1805 offers the following main features:

PCIe-Bus Plug & Play

The PCIE-1805 card uses a PCIe controller to interface the card to the PCI Express bus. The controller fully implements the PCI Express Base Specification v1.1. All configurations related to the bus, such as base address and interrupt assignment, are automatically controlled by software. No jumper or switch is required for user configuration.

Onboard Buffer Memory

There is a 4k-sample buffer for AI on PCIE-1805. This is an important feature for faster data transfer and more predictable performance.

Configurable Measurement Mode

PCIE-1805 provides a function current measurement of ranging 0-20mA or 4-20mA for users to choose from. It provides an onboard dip-switch for users to change measurement mode between voltage and current.

BoardID Switch

The PCIE-1805 has a built-in DIP switch that helps define each card's ID when multiple PCIE-1805 cards have been installed on the same PC chassis. The BoardID setting function is very useful when building a system with multiple PCIE-1805 cards. With the correct BoardID settings, you can easily identify and access each card during hardware configuration and software programming.

Note! *For detailed specifications and operation theory of the PCIE-1805, please refer to Appendices A and B.*

1.2 Applications

- Transducer and sensor measurements
- Waveform acquisition and analysis
- Vibration and transient analysis

1.3 Installation Guide

Before you install your PCIE-1805 card, please make sure you have the following necessary components:

- PCIE-1805 DA&C card
- PCIE-1805 User Manual
- Driver software Advantech DAQNavi software (downloaded from Advantech website)
- Personal computer or workstation with a PCI Express interface (running Windows 10, 8 and 7)
- Shielded Cable PCL-10162 (optional)
- Wiring Board ADAM-3962 (optional)

Other optional components are also available for enhanced operation:

- DAQ Navi, LabView or other 3rd-party software

After you get the necessary components and maybe some of the accessories for enhanced operation of your multifunction card, you can then begin the installation procedure. Figure 1.1 on the next page provides a concise flow chart to give you a broad picture of the software and hardware installation procedures:

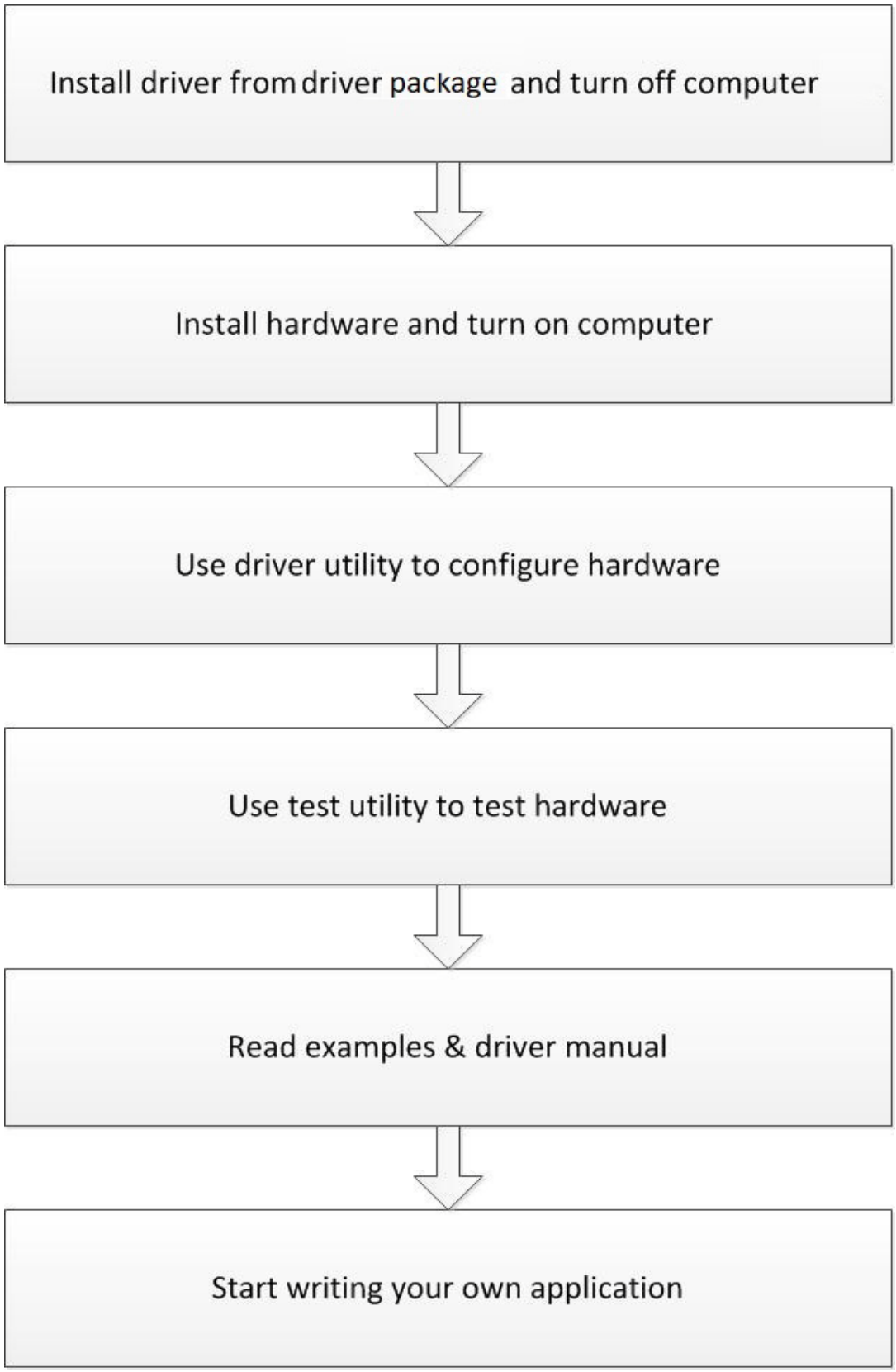


Figure 1.1 Installation Flow Chart

1.4 Software Overview

Advantech offers a rich set of DLL drivers, third-party driver support, and application software to help fully exploit the functions of your PCIE-1805 card:

- Device Drivers (downloaded from Advantech website)
- LabVIEW driver
- Advantech DAQNavi
- Datalogger

Programming Choices for DA&C Cards

You may use Advantech application software such as Advantech Device Drivers. On the other hand, advanced users can use register-level programming, although this is not recommended due to its laborious and time-consuming nature.

DAQNavi Software

Advantech DAQNavi software includes device drivers and SDK, which features a complete I/O function library to help boost your application performance. The Advantech DAQNavi software for Windows XP/7/8 (desktop mode) works seamlessly with development tools such as Visual Studio.NET, Visual C++, Visual Basic and Borland Delphi.

1.5 DAQNavi Device Driver Programming Roadmap

This section will provide you a roadmap to demonstrate how to build an application from scratch using Advantech DAQNavi Device Driver with your favorite development tools such as Visual Studio.NET, Visual C++, Visual Basic, Delphi, and C++ Builder. The step-by-step instructions on how to build your own applications using each development tool is given in the Device Drivers Manual. A rich set of example source code is also provided for your reference.

Programming Tools

Programmers can develop application programs with their favorite development tools:

- Visual Studio .NET
- Visual C++ and Visual Basic
- Delphi
- C++ Builder

For instructions on how to begin programming work in each development tool, Advantech offers a Tutorial Chapter in the *DAQNavi SDK Manual* for your reference. Please refer to the corresponding sections in this chapter on the *DAQNavi SDK Manual* to begin your programming efforts. You can also look at the example source code provided for each programming tool; examples can help jump-start a project.

The *DAQNavi SDK Manual* can be found after you installed the manual package(DAQNavi_Programing_References, which can be downloaded on Advantech support portal). Alternatively, if you have already installed the manual package on your system, The *DAQNavi SDK Manual* can be readily accessed through the Start button:

Start/Programs/Advantech Automation/DAQNavi/DAQNavi Manuals/DAQNavi SDK Manual

The example source code can be found under the corresponding installation folder such as the default installation path:

\Advantech\DAQNavi\Examples

For information about using other function groups or other development tools, please refer to the Using DAQNavi SDK chapter in the DAQNavi SDK Manual, or the video tutorials in the Advantech Navigator.

Programming with DAQNavi Device Drivers Function Library

Advantech DAQNavi Device Drivers offer a rich function library that can be utilized in various application programs. This function library consists of numerous APIs that support many development tools, such as Visual Studio .NET, Visual C++, Visual Basic, Delphi and C++ Builder.

According to their functions or services, APIs can be categorized into several function groups:

- Analog Input Function Group

For the usage and parameters of each function, please refer to the *Using DAQNavi SDK* chapter in the *DAQNavi SDK Manual*.

Troubleshooting DAQNavi Device Drivers Error

Driver functions will return a status code when they are called to perform a certain task for the application. When a function returns a code that is not zero, it means the function has failed to perform its designated function. To troubleshoot the Device Drivers error, you can pass the error, you can check the error code and error description within the Error Control of each function in the DAQNavi SDK Manual.

1.6 Accessories

Advantech offers a complete set of accessory products to support the PCIE-1805 card. These accessories include:

Wiring Cables

- **PCL-10162-1E** DB-62 Shielded Cable, 1m
- **PCL-10162-3E** DB-62 Shielded Cable, 3m
- **1700030423-01** 10 pin Flat Cable, 10cm

Wiring Boards

- **ADAM-3962-AE** DB-62 Wiring Terminal, DIN-rail Mount

Chapter 2

Installation

2.1 Unpacking

After receiving your PCIE-1805 package, inspect its contents first.

The package should contain the following items:

- PCIE-1805 card
- Startup Manual

The PCIE-1805 cards harbors certain electronic components vulnerable to electrostatic discharge (ESD). ESD could easily damage the integrated circuits and certain components if preventive measures are not carefully paid attention to.

Before removing the card from the antistatic plastic bag, you should take following precautions to prevent ESD damage:

- Touch a metal part of your computer chassis with your hand to discharge static electricity accumulated on your body. Or use a grounding strap.
- Touch the anti-static bag to a metal part of your computer chassis before opening the bag.
- Hold the card only by the metal bracket when removing it from the bag.

After taking out the card, you should first inspect the card for any possible signs of external damage (loose or damaged components, etc.). If the card is visibly damaged, please notify our service department or the local sales representative immediately. Avoid installing a damaged card into your system. Also, pay extra caution to the following aspects to ensure proper installation:

- Avoid physical contact with materials that could hold static electricity such as plastic, vinyl and Styrofoam.
- Whenever you handle the card, grasp it only by its edges. DO NOT TOUCH the exposed metal pins of the connector or the electronic components.

Note! *Keep the anti-static bag for future use. You may need the original bag to store the card if you have to remove the card from the PC or transport it elsewhere.*

2.2 Driver Installation

We recommend you install the driver before you install the PCIE-1805 card into your system, since this will guarantee a smooth installation process.

2.2.1 Device Auto Installation (Recommended)

You can install the PCIE-1805 in any PCI Express slot on your computer. Follow the steps below to install the module on your system.

1. Turn off your computer and unplug the power cord and cables. TURN OFF your computer before installing or removing any components on the computer.
2. Remove the cover of the computer.
3. Remove the slot cover on the back panel of your computer.
4. Touch the metal part on the surface of your computer to neutralize the static electricity that might be on your body.
5. Insert the PCIE-1805 card into a PCI Express slot. Hold the card only by its edges and carefully align it with the slot. Insert the card firmly into place. Use of excessive force must be avoided, otherwise the card might be damaged.

6. Fasten the bracket of the PCI card on the back panel rail of the computer with screws.
7. Plug in the power cord and turn on the computer.

2.3 Device Setup & Configuration

The *Advantech Navigator* program is a utility that allows you to set up, configure and test your device, and later stores your settings on the system registry. These settings will be used when you call the APIs of Advantech Device Drivers.

Setting Up the Device

1. To set up the I/O device for your card, you must first run the Advantech Navigator program (by accessing Start/Programs/Advantech Automation/DAQNavi/Advantech Navigator).
2. You can then view the device(s) already installed on your system (if any) on the Installed Devices list box. If the software and hardware installation are completed, you will see PCIE-1805 card in the Installed Devices list.

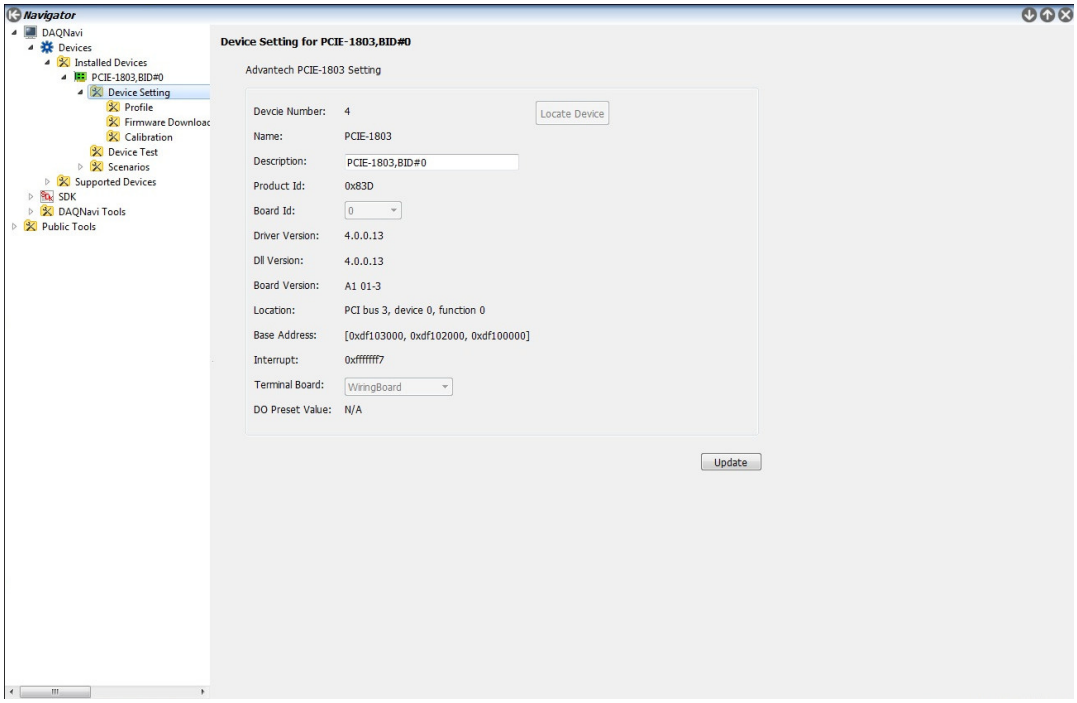


Figure 2.1 The Device Setting of PCIE-1805

Configuring the Device

Go to the Device Setting to configure your device. Here you can configure not only the Analog Input of PCIE-1805 but also Digital Input/Output.

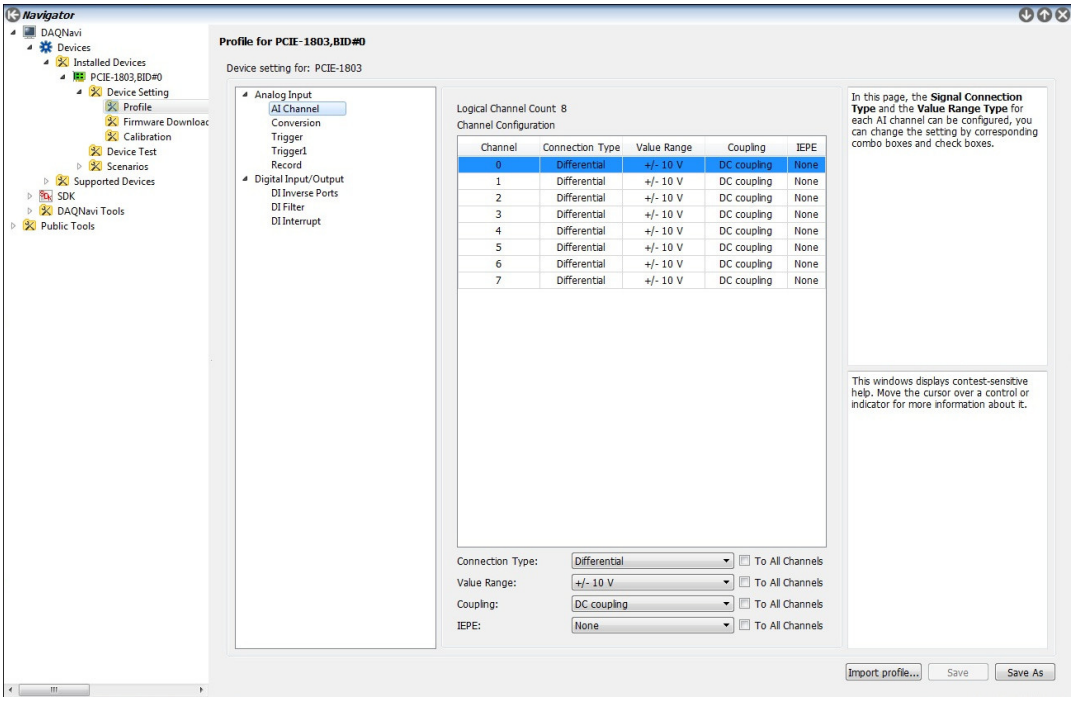


Figure 2.2 The Device Setting page

After your card is properly installed and configured, you can go to the Device Test page to test your hardware by using the testing utility supplied.

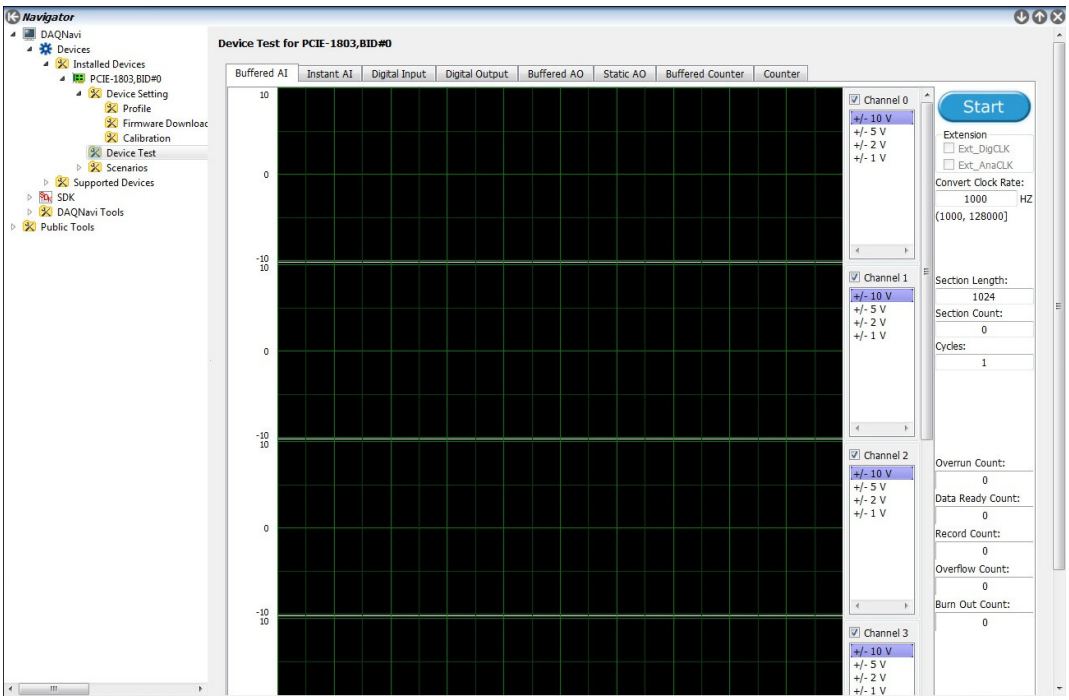


Figure 2.3 The Device Testing of PCIE-1805

For more detailed information, refer to the DAQNavi SDK Manual or the User Interface Manual in the Advantech Navigator.

Chapter 3

Signal Connections

This chapter provides useful information about how to connect input and output signals to the PCIE-1805 card via the I/O connector.

Sections include:

- Overview
- Board ID Settings
- Signal Connections
- Field Wiring Considerations

3.1 Overview

Maintaining signal connections is one of the most important factors in ensuring that your application system is sending and receiving data correctly. A good signal connection can avoid unnecessary and costly damage to your PC and other hardware devices. This chapter provides useful information about how to connect input and output signals to the PCIE-1805 card via the I/O connector.

3.2 Switch and Jumper Settings

Please refer to Figure 3.1 for jumper and switch locations on PCIE-1805.

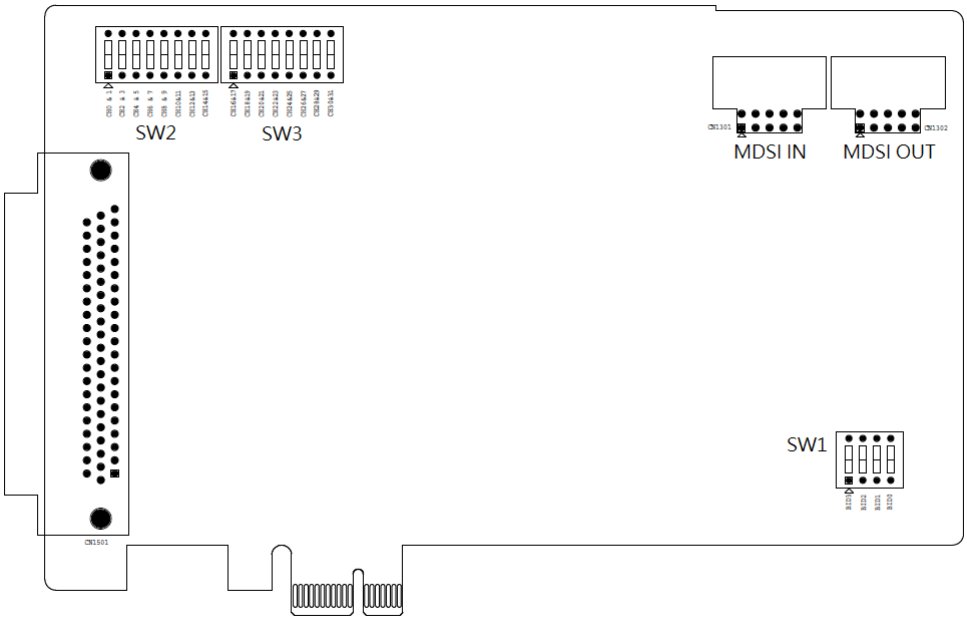


Figure 3.1 Connector and Switch Locations

3.2.1 Board ID (SW1)

The PCIE-1805 has a built-in DIP switch (SW1), which is used to define each card's board ID. When there are multiple cards on the same chassis, this board ID switch is used to set each card's device number.

After setting each PCIE-1805, you can identify each card in system with different device numbers. The default value of board ID is 0 and if you need to adjust it to other value, please set the SW1 by referring to Table 3.1.

Table 3.1: Board ID Setting (SW1)

SW1	Position 1	Position 2	Position 3	Position 4
BoardID	Bit0	Bit1	Bit2	Bit3
0	ON	ON	ON	ON
1	ON	ON	ON	OFF
2	ON	ON	OFF	ON
3	ON	ON	OFF	OFF
4	ON	OFF	ON	OFF
5	ON	OFF	ON	OFF
6	ON	OFF	OFF	ON
7	ON	OFF	OFF	OFF
8	OFF	ON	ON	ON
9	OFF	ON	ON	OFF
10	OFF	ON	OFF	ON
11	OFF	ON	OFF	OFF
12	OFF	OFF	ON	ON
13	OFF	OFF	ON	OFF
14	OFF	OFF	OFF	ON
15	OFF	OFF	OFF	OFF

Default Setting is 0

3.3 Signal Connections

Pin Assignments

The I/O connector on the PCIE-1805 is a 62-pin connector that allows you to connect to accessories with the PCL-10162 shielded cable.

Figure 3.2 shows the pin assignments for the 62-pin I/O connector on the PCIE-1805, and Table 3.3 shows its I/O connector signal description.

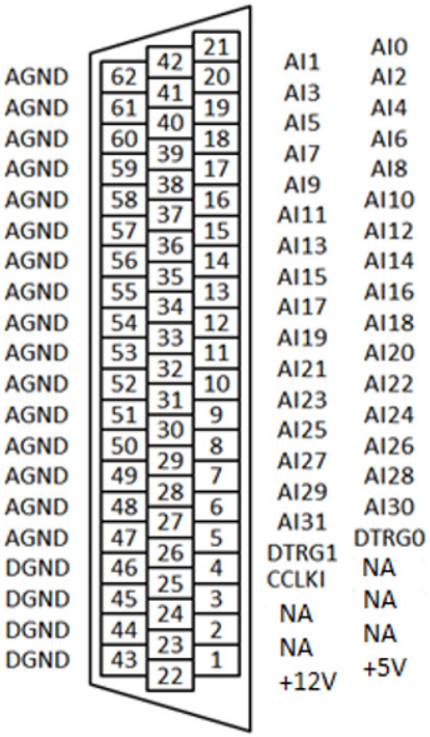


Figure 3.2 62-pin I/O Connector Pin Assignments

3.3.1 I/O Connector Signal Description

Pin Name	Type	Pin#	Description
		Analog Input	
AI0	I	21	Analog input channel 0
AI1	I	42	Analog input channel 1
AI2	I	20	Analog input channel 2
AI3	I	41	Analog input channel 3
AI4	I	19	Analog input channel 4
AI5	I	40	Analog input channel 5
AI6	I	18	Analog input channel 6
AI7	I	39	Analog input channel 7
AI8	I	17	Analog input channel 8
AI9	I	38	Analog input channel 9
AI10	I	16	Analog input channel 10
AI11	I	37	Analog input channel 11
AI12	I	15	Analog input channel 12
AI13	I	36	Analog input channel 13
AI14	I	14	Analog input channel 14
AI15	I	35	Analog input channel 15
AI16	I	13	Analog input channel 16
AI17	I	34	Analog input channel 17
AI18	I	12	Analog input channel 18
AI19	I	33	Analog input channel 19
AI20	I	11	Analog input channel 20
AI21	I	32	Analog input channel 21
AI22	I	10	Analog input channel 22
AI23	I	31	Analog input channel 23
AI24	I	9	Analog input channel 24
AI25	I	30	Analog input channel 25
AI26	I	8	Analog input channel 26
AI27	I	29	Analog input channel 27
AI28	I	7	Analog input channel 28
AI29	I	28	Analog input channel 29
AI30	I	6	Analog input channel 30
AI31	I	27	Analog input channel 31
		Timing Signals	
DTRG0	I	5	External digital trigger 0
DTRG1	I	26	External digital trigger 1
CCLKI	I	4	External conversion clock input
		Power and Ground	
+12V	-	22	+12 V power supply for external use
+5V	-	1	+5 V power supply for external use
AGND	-	47 ~ 63	Ground for analog signals
DGND	-	43 ~ 46	Ground for digital signals
		RESERVED	

NA	-	2	Reserved
NA	-	3	Reserved
NA	-	23	Reserved
NA	-	24	Reserved
NA	-	25	Reserved

3.3.2 Measurement Mode Selection

Current Measurement Setting (SW2 & SW3)

PCIE-1805 provides a function current measurement of ranging 0-20mA or 4-20mA for users to choose from. To use this function, you should follow below procedure:

1. Set corresponded current measurement channel on SW2 and SW3 (Voltage: OFF, Current: ON)
2. Set the channel to differential
3. Set the value range to 0-20mA or 4-20mA

		SW2	
Switch No.	Channel	Switch No.	Channel
1	CH0 & 1	5	CH8 & 9
2	CH2 & 3	6	CH10 & 11
3	CH4 & 5	7	CH12 & 13
4	CH6 & 7	8	CH14 & 15
		SW3	
1	CH16 & 17	5	CH24 & 25
2	CH18 & 19	6	CH26 & 27
3	CH20 & 21	7	CH28 & 29
4	CH22 & 23	8	CH30 & 31

3.3.3 Analog Input Connections

PCIE-1805 supports 32 single-ended analog inputs and 16 differential inputs.

Differential Channel Connections

The differential input channels operate with two signal wires for each channel, and the voltage difference between both signal wires is measured.

If one side of the signal source is connected to a local ground, the signal source is ground-referenced. Therefore, the ground of the signal source and the ground of the card will not be exactly the same voltage. The difference between the ground voltages forms a common-mode voltage (Vcm).

To avoid the ground loop noise effect caused by common-mode voltages, you can connect the signal ground to the Low input. Figure 3-3 shows a differential channel connection between a ground reference signal source and an input channel on the PCIE-1805. With this connection, the PGIA rejects a common-mode voltage Vcm between the signal source and the PCIE-1805 ground, shown as Vcm in Figure 3-4.

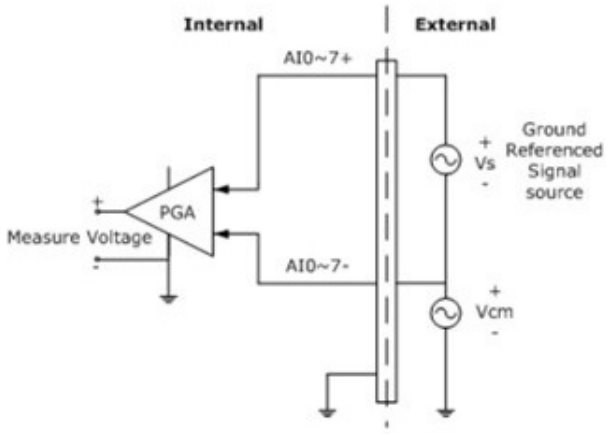


Figure 3.3 Differential Input Channel Connections

If a floating signal source is connected to the differential input channel, the signal source might exceed the common-mode signal range of the PGIA, and the PGIA will be saturated with erroneous voltage-readings. You must therefore reference the signal source against the AGND.

Figure 3-4 shows a differential channel connection between a floating signal source and an input channel on the PCIE-1805. In this figure, each side of the floating signal source is connected through a resistor to the AGND. This connection can reject the common-mode voltage between the signal source and the PCIE-1805 ground

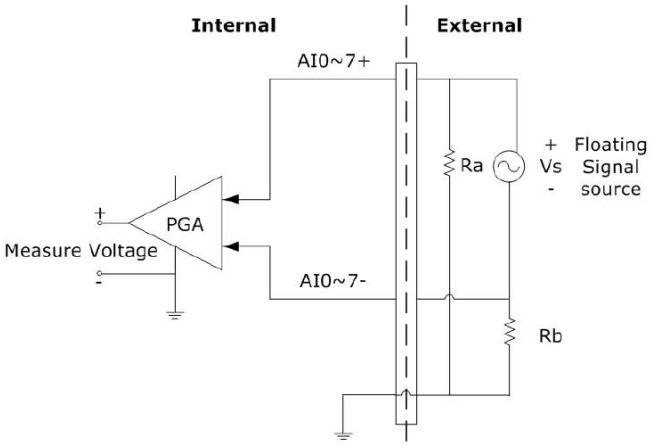
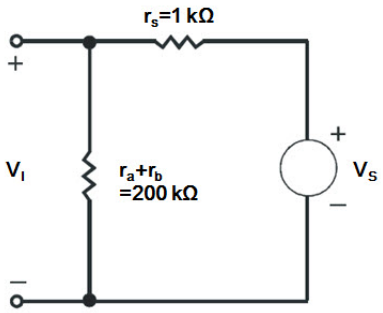


Figure 3.4 Differential Input Channel Connection - Floating Signal Source

However, this connection has the disadvantage of loading the source down with the series combination (sum) of the two resistors. For ra and rb, for example, if the input impedance rs is 1k Ohm, and each of the two resistors is 100k Ohm, then the resistors load down the signal source with 200 Ohm (100 Ohm+ 100 Ohm), resulting in a -0.5% gain error. The following gives a simplified representation of the circuit and calculating process.



V_S: ideal signal source

V_I: measured signal source

r_s: output impedance of signal source

r_a, r_b: series-wound resistors

$$V_I = \frac{r_a + r_b}{r_s + r_a + r_b} V_S = \frac{200}{1 + 200} V_S = \frac{200}{201} V_S$$

$$\text{Gain error} = \frac{V_I - V_S}{V_S} = -\frac{1}{201} = -0.5\%$$

AI Sample Clock Sources Connections

Internal AI Sample Clock

The internal AI sample clock uses a 100 MHz time base. Conversions start on the rising edge of the counter output. You can use software to specify the clock source as internal and the sampling frequency to pace the operation. The minimum frequency is 5.96 S/s, the maximum frequency is 1 MS/s. According to the sampling theory (Nyquist Theorem), you must specify a frequency that is at least twice as fast as the input's highest frequency component to achieve a valid sampling. For example, to accurately sample a 20 kHz signal, you have to specify a sampling frequency of at least 40 kHz. This consideration can avoid an error condition often know as aliasing, in which high frequency input components appear erroneously as lower frequencies when sampling.

External AI Sample Clock

The external AI sample clock is useful when you want to pace acquisitions at rates not available with the internal AI sample clock, or when you want to pace at uneven intervals. Connect an external AI sample clock to screw terminal CCLK on the screw terminal board. Conversions will start on the rising edge of the external AI sample clock input signal. You can use software to specify the clock source as external. The sampling frequency is always limited to a maximum of 10 MHz for the external AI sample clock input signal.

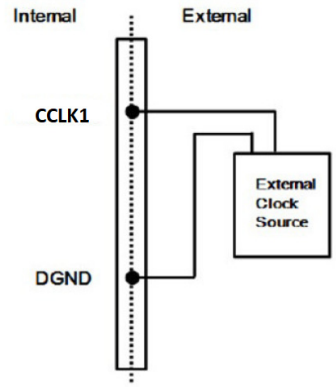


Figure 3.5 External Clock Source Connection

Trigger Sources Connections

External Digital (TTL) Trigger

For analog input operations, an external digital trigger event occurs when the PCIE-1805 detects either a rising or falling edge on the External AI TTL trigger input signal from screw terminal DTRG0 and DTRG1 on the screw terminal board. The trigger signal is TTL-compatible.

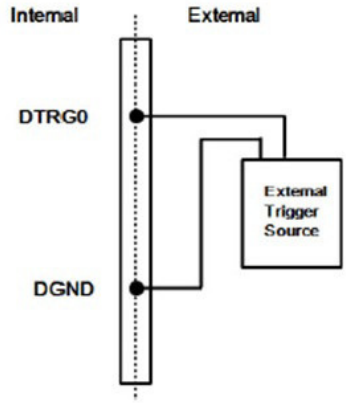


Figure 3.6 External Digital Trigger Source Connection

Analog Threshold Trigger

For analog input operations, an analog trigger event occurs when the PCIE-1805 detects a transition from above a threshold level to below a threshold level (falling edge), or a transition from below a threshold level to above a threshold level (rising edge). The trigger source can be chosen from any of the analog input channels, i.e. AI0 - AI31.

3.4 Field Wiring Considerations

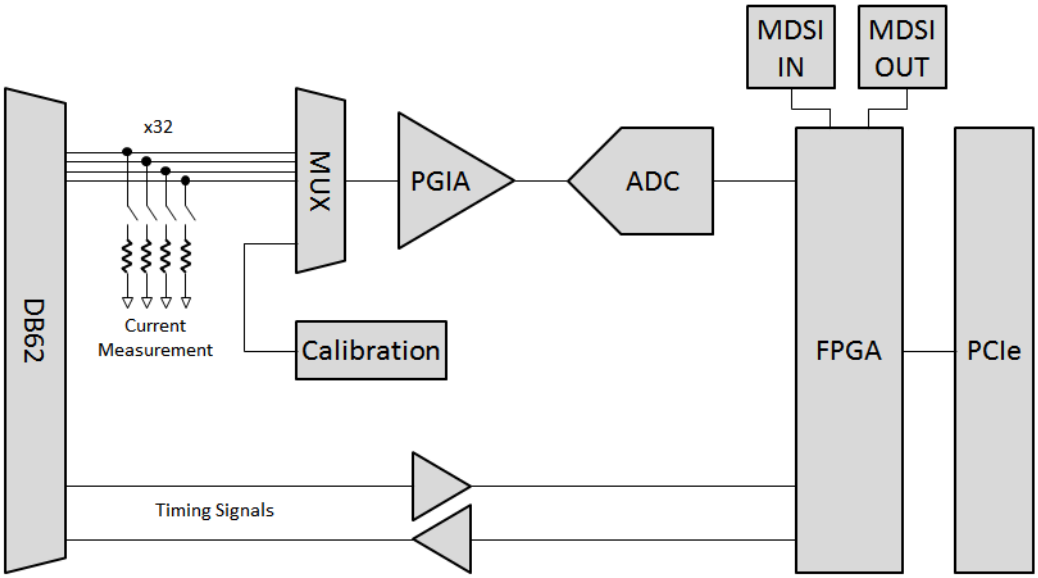
When you use PCIE-1805 cards to acquire data from outside, noises in the environment might significantly affect the accuracy of your measurements if due cautions are not taken. The following measures will be helpful to reduce possible interference running signal wires between signal sources and the PCIE-1805 card.

- The signal cables must be kept away from strong electromagnetic sources such as power lines, large electric motors, circuit breakers or welding machines, since they may cause strong electromagnetic interference. Keep the analog signal cables away from any video monitor, since it can significantly affect a data acquisition system.
- If the cable travels through an area with significant electromagnetic interference, you should adopt individually shielded, twisted-pair wires as the analog input cable. This type of cable has its signal wires twisted together and shielded with a metal mesh. The metal mesh should only be connected to one point at the signal source ground.
- Avoid running the signal cables through any conduit that might have power lines in it.
- If you have to place your signal cable parallel to a power line that has a high voltage or high current running through it, try to keep a safe distance between them. Alternatively, you can place the signal cable at a right angle to the power line to minimize the undesirable effect.
- The signals transmitted on the cable will be directly affected by the quality of the cable. In order to ensure better signal quality, we recommend that you use PCL-10162 shielded cable.

Appendix A

Specifications

A.1 Function Block



A.2 Analog Input

A.2.1 Functions

Channels	32 single-ended/16 differential, or mixed. Can be enabled/disabled each channel independently by software
Input coupling	DC
Input range	±10 V, ±5 V, ±2 V, ±1 V, 0 ~ 20 mA, and 4 ~ 20 mA
A/D converter (ADC) resolution	16 bits
A/D converter (ADC) type	Successive approximation (SAR)
Maximum sample rate (fs)	1 MS/s shared by all enabled channels
Sample clock source	
Programmable internal source	100 MHz/n, where n = 100 ~ 16777216
External source	0 ~ 1 MHz
Trigger mode	Start trigger, delay to start trigger, stop trigger, delay to stop trigger
Maximum working voltage for all analog inputs	±11 V for all ranges
Common-mode rejection ratio (CMRR, at 60 Hz)	85 dB
Input impedance	
AI+ to AGND	>1,000 GΩ in parallel with 9 pF
A+ to A-	>1,000 GΩ in parallel with 6 pF
Input bias current	1pA
Input FIFO size	4,095 samples shared by all enabled channels
Data transfers	DMA, programmed I/O
Overvoltage protection for all channels	±15 V

A.2.2 Voltage Measurement Accuracy

- Gain error
  Operating temperature within 5 °C of last auto-calibration temperature: < ±0.01 %
  Over full operating temperature range: < ±0.03 %
- Offset error
  Operating temperature within 5 °C of last auto-calibration temperature: < ±0.5 mV
  Over full operating temperature range: < ±1.5 mV

A.2.3 Current Measurement Accuracy

- Gain error
  Operating temperature within 5 °C of last auto-calibration temperature: < ±0.05 %
  Over full operating temperature range: < ±0.15 %
- Offset error
  Operating temperature within 5 °C of last auto-calibration temperature: < ±2.5 µA
  Over full operating temperature range: < ±10 µA

A.2.4 Dynamic Performance

-3 dB bandwidth	3 MHz
RMS Noise	0.1 mV
Effective number of bits (ENOB)	17.5 Bits
Crosstalk (at 1kHz)	
Adjacent Channels	-75 dB
Non-adjacent Channels	-77 dB

A.3 Triggers

Trigger function	Start trigger/delay to start trigger/stop trigger/delay to stop trigger
Delay range	1 ~ 16777216 samples

A.3.1 Analog Trigger

Channels	2
Source	Any analog input channel
Threshold level	Full scale of analog input range, software programmable
Resolution	16 bits
Hysteresis	Software programmable
Polarity	Rising edge/falling edge, software selectable

A.3.2 External Digital Trigger

Channels	2
Polarity	Rising edge/falling edge, software selectable

A.4 Timing Signals

A.4.1 Timing Signal Inputs

Input high voltage (VIH)	2.0 V min.
Input low voltage (VIL)	0.8 V max.
Maximum input voltage	6.5 V
Minimum input voltage	-0.5 V
Propagation delay	100 ns

A.5 Output Capacity

+5 V	200 mA max.
+12 V	100 mA max.

A.6 General

Form factor	x1 PCI Express, specification v1.1 compliant
Slot compatibility	x1, x4, x8, and x16 PCI Express slots
Power Consumption	
+3.3 V	300 mA typ./320 mA max.
+12 V	70 mA typ./90 mA max.
Printed circuits board dimensions	168 × 99 mm (6.6 × 3.9 in.)
I/O connector	62-pin D-sub × 1
Operating temperature	0 to 60 °C (32 to 140 °F)
Storage temperature	-40 to 70 °C (-40 to 158 °F)
Operating humidity	10 to 90% RH, non-condensing
Storage humidity	5 to 95% RH, non-condensing

Appendix B

Operation Theory

B.1 Analog Input Operation

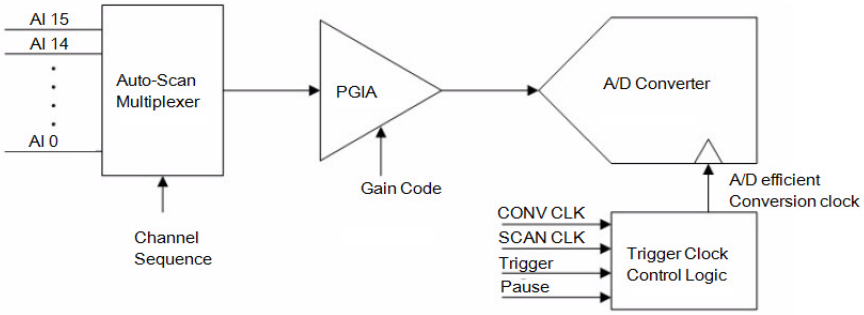
This section describes the following features of analog input operation theory that can help you realize how to configure the functions and parameters to match various applications.

- AI Hardware Structure
- Analog input ranges and gains
- Analog data acquisition mechanism
- Analog input acquisition modes
- AI SCAN/CONV clock source
- AI trigger sources
- Analog input data format

B.1.1 AI Hardware Structure

The AI conversion hardware structure includes four major parts:

- **PGIA** (Programmable Gain Instrument Amplifier) rectifies the input range and amplify/alleviate input signal to match the input range of A/ D converter.
- **AI converter** conceives the rectified voltage from PGIA and transfers it into the corresponding digital data format.
- **Trigger/Clock control logic** enables/disables the whole process and determines acquisition timing interval.



AI Conversion Hardware Structure

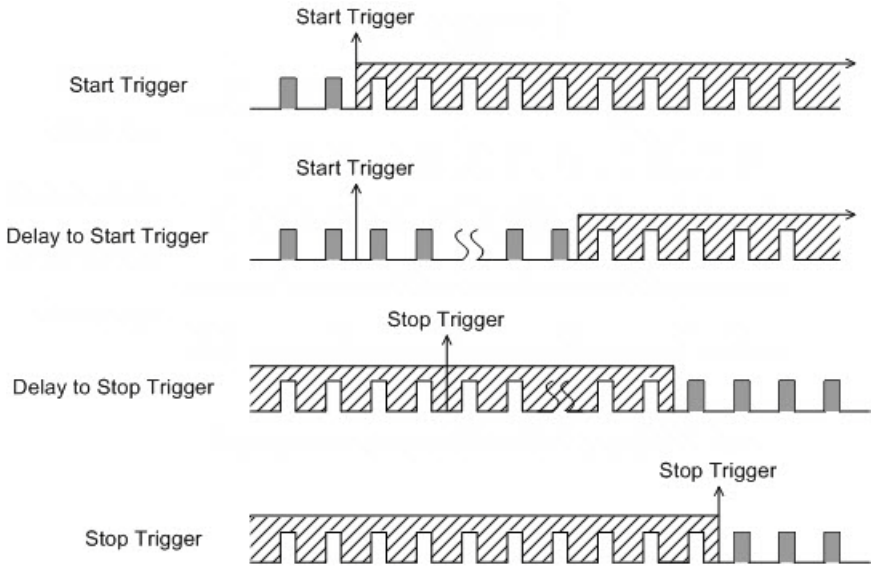
B.1.2 Analog Input Ranges and Gains

The PCIE-1805 can measure both unipolar and bipolar analog input signals. A unipolar signal can range from 0 to 10 V FSR (Full Scale Range), while a bipolar signal extends within ±10 V FSR. The PCIE-1805 provides various programmable gain levels and each channel is allowed to set its own input range individually. Table B.1 lists the effective ranges supported by the PCIE-1805 with gains.

For each channel, choose the gain level providing the most optimal range that can accommodate the signal range you want to measure.

B.1.3 AI Trigger Modes

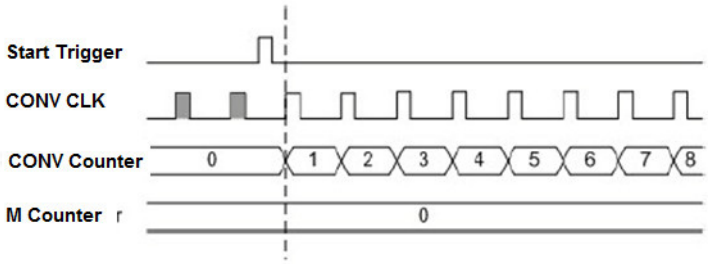
The PCIE-1805 supports four trigger modes and pause function. User can start or stop the operation by trigger mode selection. An extra 24-bit counter is dedicated to delay-trigger mode and about-trigger mode. Figure shows the four different trigger modes.



Trigger Modes

- **Start Trigger Acquisition Mode**

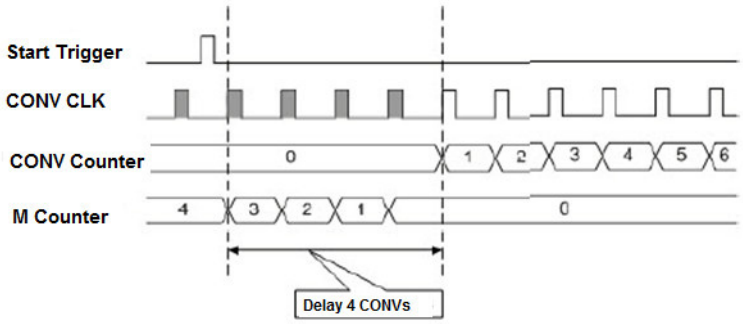
  Start trigger acquisition starts when the PCIE-1805 detects the trigger event and stops when you stop the operation. The CONV CLKs before Trigger will be blocked out. You can set post-trigger acquisition mode by software.



Start Trigger (M = 0)

- **Delay to Start Trigger Acquisition Mode**

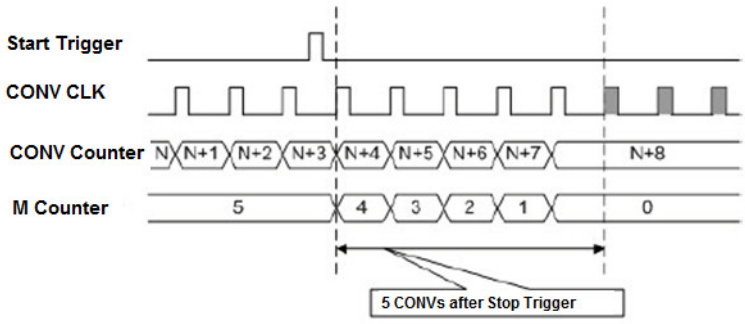
  In delay to start trigger mode, data acquisition will be activated after a preset delay number of CONV CLKs has been taken after the trigger event. User can set the delay number of CONV CLKs by a 24-bit counter. Delay to start trigger acquisition starts when the PCIE-1805 detects the trigger event and stops when you stop the operation.



Delay to Start Trigger (M = 4)

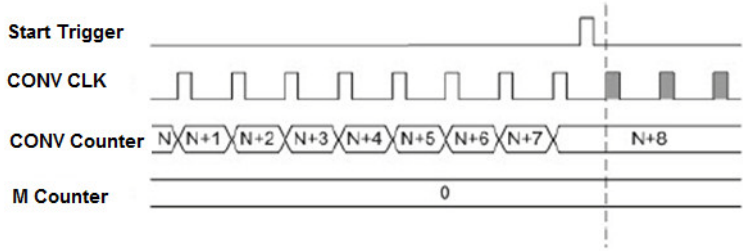
- **Delay to Stop Trigger Acquisition Mode**

  If you want to acquire data after a specific trigger event occurs, then you can take advantage of the delay to stop trigger mode. First designate the size of the allocated memory and the amount of samples to be snatched after the trigger event happens. The about trigger acquisition starts when the first CONV CLK signal comes in. Once a trigger event happens, the on-going data acquisition will continue until the designated amount of CONV CLKs have been reached. When the PCIE-1805 detects the selected about-trigger event, the card keeps acquiring the preset number of samples, and keeps them on the buffer.



- **Stop Trigger Acquisition Mode**

  Stop trigger mode is a particular application of about-trigger mode. Use pre-trigger acquisition mode when you want to acquire data before a specific trigger event occurs. Stop-trigger acquisition starts when you start the operation and stops when the trigger event happens.



B.1.4 AI CONV Clock Source

The PCIE-1805 can adopt both internal and external clock sources to accomplish pacer acquisition. You can set the clock and trigger sources conveniently by software. The figure can help you understand the routing route of clock and trigger generation.

CONV Clock

- Internal AI CONV clock derived from 32-bit divider
- External AI CONV clock from terminal board

- **Internal AI CONV Clock**
  The internal AI CONV clock applies 100 MHz time base accompanied with 32-bit divider. The maximum frequency is 250 KS/s. According to the sampling theory (Nyquist Theorem), you must specify a frequency that is at least twice as fast as the input's highest frequency component to achieve a valid sampling. For example, to accurately sample a 20 kHz signal, you have to specify a sampling frequency of at least 40 kHz. This consideration can avoid an error condition often know as aliasing, in which high frequency input components appear erroneously as lower frequencies when sampling.

- **External AI CONV Clock**
  The external AI CONV Clock is convenient in uneven sampling internal. AI conversion will start by each arriving rising edge. The sampling frequency is always limited to a maximum of 250 KHz.

B.1.5 AI Trigger Source

The PCIE-1805 supports the following trigger sources for start, delay to start, delay to stop, stop trigger acquisition modes:

- External digital (TTL) trigger
- Analog threshold trigger

With PCIE-1805, user can also define the type of trigger source as rising-edge or falling-edge. These following sections describe these trigger sources in more detail.

- **External Digital (TTL) Trigger**

For analog input operations, an external digital trigger event occurs when the PCIE-1805 detects either a rising or falling edge on the External AI TTL trigger input. The trigger signal is TTL compatible.

- **Analog Threshold Trigger**

For analog input operations, an analog trigger event occurs when the PCIE-1805 detects a transition from above a threshold level to below a threshold level (falling edge), or a transition from below a threshold level to above a threshold level (rising edge). User should connect analog signals from external device or analog output channel on board to external input signal ATRG0/1. On the PCIE-1805, the threshold level is set using a dedicated 16-bit DAC. By software, you can program the threshold level by writing a voltage value to this DAC; this value can range from -10 V to +10 V.

Table B.1: Analog Input Data Format

AI Code		Mapping Voltage	
Hex.	Dec.	Unipolar	Bipolar
0000 h	0 d	0	- FS/2
7FFF h	32767 d	FS/2 - 1 LSB	- 1LSB
8000 h	32768 d	FS/2	0
FFFF h	65535 d	FS - 1 LSB	FS/2 - 1 LSB
1 LSB		FS/65536	FS/65536

Table B.2: Full Scale Values for Input Voltage Ranges

Gain	Unipolar		Bipolar	
	Range	FS	Range	FS
0.5	N/A	N/A	± 10 V	20
1	0 ~ 10 V	10	± 5 V	10
2	0 ~ 5 V	5	± 2.5 V	5
4	0 ~ 2.5 V	2.5	± 1.25 V	2.5
8	0 ~ 1.25 V	1.25	± 0.625 V	1.25

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Please verify specifications before quoting. This guide is intended for reference purposes only.

All product specifications are subject to change without notice.